

CLAIMS

[1] An over-current protection circuit of a semiconductor circuit including a power transistor for outputting current output, a first output current detection circuit and a current limiter circuit for limiting the output current by stopping the output current of the power transistor for a predetermined period in response to a first detection signal from the output current detection circuit when the output current of the power transistor reaches a predetermined limit value, comprising:

an output current detection transistor current-mirror connected to the power transistor; and

a second output current detection circuit for generating a second detection signal according to an output current of the output current detection transistor when the output current reaches a predetermined value larger than the predetermined limit value,

wherein the output current of the power transistor is cut off for the predetermined period by operating the current limiter circuit in response to the second detection signal.

[2] The over-current protection circuit as claimed in claim 1, wherein the semiconductor circuit is a motor driver circuit IC, the predetermined value is set in a range within which a continuous drive of a motor by the power transistor is possible without any trouble.

[3] The over-current protection circuit as claimed in claim 2, wherein the predetermined value is in a range higher than the predetermined limit value by 5% to 10% of the predetermined limit value, the output current detection circuit includes a first resistor provided externally of the IC and connected to a predetermined terminal of the IC and the first detection signal

is a terminal voltage generated in the first resistor.

[4] The over-current protection circuit as claimed in claim 3, wherein the current limiter circuit includes a comparator, the comparator compares the terminal voltage generated in the first resistor with a predetermined reference voltage and generates an output signal for cutting off the output current for the predetermined period according to a result of the comparison and the comparator compares a voltage signal generated according to the second detection signal with the predetermined voltage and generates the output signal according to a result of the comparison.

[5] The over-current protection circuit as claimed in claim 4, further comprising a chopping pulse generator circuit and a timer circuit, wherein the predetermined period is a constant period, the timer circuit is actuated by the output signal to measure the constant period, the chopping pulse generator circuit generates a pulse every constant period set by the timer circuit and the power transistor is ON/OFF controlled by the pulse.

[6] The over-current protection circuit as claimed in claim 3, wherein the output current is a sink current from an output terminal of the power transistor and the motor is driven by the sink current.

[7] The over-current protection circuit as claimed in claim 6, further comprising a second resistor provided between the output current detection transistor and a reference voltage line, wherein the power transistor and the output current detection transistor are N channel MOS transistors and the second detection signal is generated correspondingly to a terminal voltage in the second resistor.

[8] The over-current protection circuit as claimed in claim 7, further comprising a transistor for detecting an over-current, which is turned ON when the terminal voltage of the second resistor exceeds a certain value, and a third resistor provided within the motor driver IC between the predetermined terminal and the comparator, wherein the second detection signal is generated when the transistor is turned ON to generate a voltage higher than the predetermined reference voltage at a terminal of the third resistor.

[9] The over-current protection circuit as claimed in claim 8, wherein the terminal of the over-current detection transistor at which a ground current is generated and a terminal of the second resistor connected to the reference voltage line are connected to the predetermined terminal.

[10] A motor drive circuit comprising the over-current protection circuit claimed in any of claims 1 to 9, wherein the semiconductor circuit is an IC.

[11] The motor drive circuit as claimed in claim 10, wherein the output terminal of the power transistor is connected to a stepping motor.

[12] A semiconductor device comprising a motor drive circuit as claimed in claim 10 or 11.